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Yuichi Tokita

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WOLF GREENFIELD & SACKS, P.C.  
600 ATLANTIC AVENUE  
BOSTON, MA 02210-2206

EXAMINER

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.



## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 3/7/2008 has been entered.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

1. Claims 1-11 and 13-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wariishi et al. (US Patent 6376765) in view of Osuka (WO 02/14322). Since the publication of Osuka is in Japanese, citations below are given to the U.S. Patent 6812343 that issued from US National Stage entry of this international application, which is an accurate translation. Also, a machine translation of this publication is attached to support the citation of the Examiner.

Regarding claims 1-7, 9-10, as seen in Figure 1, Wariishi et al. discloses a dye-sensitized solar cell comprising a semiconductor layer 20, on which a sensitizing dye having an acidic group-containing porphyrin disposed; an electrolyte layer (or charge transport layer 30) between counter electrodes 10 and 40. The porphyrin structure has acidic substituents. (See Figure 1, col. 29 formulas R-15 and R-16).

Wariishi et al. does not teach using a sensitizing dye having an acidic group containing porphyrin polymer with formulas as shown by the Applicant.

Osuka teaches using porphyrin polymer having an acidic group-containing porphyrin polymer, (See general formula 1 and col. 3 lines 64-68 and col. 4 lines 1-64). As M is 2H (See col. 3 line 30), the general formula 1 of the reference is equivalent to the general formulas in the instant claims 1 and 3. As M is a complex with metal group A (See col. 3 lines 30-36), the general formula 1 of the reference is equivalent to the general formulas in instant claims 2 and 4. Osuka also teaches n is an integer bigger than 2. (See col. 3 line 12), R1-R24 are respectively selected independently from the group consisting of hydrogen, carboxyl group, sulfonic acid (See col. 2 lines 64-68),

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carboxylic acid ... (See col. 3 lines 1-11), M is the metal complex comprising Zn, Mg, Ca ... (See col. 3 lines 42-36).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Wariishi et al. by using porphyrin polymer as taught by Osuka, because it would provide rapid non-coherent excitation energy transfer hopping and lack of an energy sink that blocks the energy transfer. (See col. 1 lines 61-68)

Regarding claim 8, Wariishi et al. describes the semiconductor comprising an oxide semiconductor. (See col. 24 lines 19-26).

Regarding claim 11, Wariishi et al. describes the semiconductor layer and the electrolyte layer are provided between a transparent base having a transparent conductive film and a conductive base serving as a counter electrode of the transparent base, and electric energy is generated between the transparent conductive film and the conductive base by a photoelectric conversion. (See Figure 1 and col. 22 lines 13-68 and col. 23 lines 1-56).

Regarding claims 13-16, Wariishi et al. in view of Osuka teaches all the structural limitations of claims 1-4 as described above, therefore the dye-sensitized solar cell of Wariishi et al. in view of Osuka would obviously achieve an efficiency of at least 7.2%. Furthermore, Wariishi et al. further suggests that a broadening photoelectric conversion wavelength region would increase photoelectric conversion efficiency (See col. 26 lines 56-65, col.54 lines 47-57 of Wariishi et al.). Osuka teaches porphyrin polymers having a broad light absorbance (See Figures 1-2). Therefore it would have been obvious to one

skilled in the art that dye-sensitized solar cell of Wariishi et al. in view of Osuka can have a solar radiation conversion efficiency of at least 7.2%.

### ***Response to Arguments***

Applicant's arguments filed 3/7/2008 have been fully considered but they are not persuasive.

Applicant continues to argue that the combination of Wariishi and Osuka is improper because neither Wariishi nor Osuka teaches or suggests that linked porphyrin is suitable for use as a dye of a dye-sensitized solar cell. However, this argument is not deemed to be persuasive. First of all, Osuka et al. teaches the multi-porphyrin system such as the disclosed porphyrin polymers can be used for opto-electronic material (See col. 1 lines 44-60 of Osuka et al.). Such opto-electronic material includes photocell (or solar cell) material (See definition of the word "optoelectronic" sent previously). Secondly, Wariishi et al. teaches using porphyrin for a dye material (See col. 28 line 44 to col. 30 of Wariishi et al.). Wariishi et al. also teaches "the light-absorption and the generation of electrons and positive holes are primarily caused in the dye, and the semiconductor fine particles receive and then convey the electrons" (See col. 23 lines 64-65 of Wariishi et al.). Osuka et al. teaches the disclosed porphyrin polymers has a strong absorbance in the visible region (See col. 1 lines 46-50 of Osuka et al.) and shows even higher peaks of absorbance in other regions (See Figures 1-2), or in other words, porphyrin polymers has a strong ability to absorb light. Osuka et al. also teaches the porphyrin polymers are "sufficient to induce rapid non-coherent excitation energy

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transfer hopping" (See col. 1 lines 64-66 of Osuka et al.), have "more electron delocalization" and can be used as "electric conducting wire" (See col. 2 lines 25-30 of Osuka et al.), which are the phenomena of generating and transporting electrons. Therefore it would certainly have been obvious to one skilled in the art to use porphyrin polymers taught by Osuka et al. in the solar cell of Wariishi et al., because Osuka et al. suggests that porphyrin polymers can be used in optoelectronic application and Wariishi et al. teaches using porphyrin as a dye. In addition, the porphyrin polymers disclosed by Osuka et al. functions exactly the way Wariishi describes a dye should be. Porphyrin polymers of Osuka et al. can absorb light and conduct electrons (See col. 1 lines 28-32 of Osuka et al.) which are the most two important characteristics in photoelectric conversion, an ordinary skill in the art would certainly use the porphyrin polymers taught by Osuka et al. in place of a dye in the solar cell of Wariishi et al. The rejection under 103(a) in combination of Wariishi and Osuka is therefore proper.

Applicant also argues that "although Osuka states that linked porphyrin has been investigated based on strong absorbance in the visible region (Col. 1, lines 28-52), Osuka does not suggest that linked porphyrin molecules have strong absorbance outside of the visible region, such as the infrared region of the electromagnetic spectrum that solar cells convert into electricity. In fact, Fig. 2 of Osuka illustrates that the absorbance of linked porphyrin molecules decreases significantly for wavelengths in the infrared region greater than about 900 nm. Since Osuka illustrates a decrease in absorbance within the infrared region, one of ordinary skill in the art would not have expected linked porphyrin to be useful for efficiently converting solar radiation into

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electricity.” Applicant appears to be arguing limitations that are not within the claims as none of the claims requires anything about absorbance in visible region or infrared region of the electromagnetic spectrum. There is in no way Wariishi limits to photoelectric conversion wavelengths to visible region or infrared region of the electromagnetic spectrum. On the contrary, Wariishi teaches broadening the photoelectric conversion to increase conversion efficiency. (See col. 26 lines 56-65, col.54 lines 47-57 of Wariishi et al.).

Applicant further argues “neither Wariishi nor Osuka teaches or suggests a dye-sensitized solar cell having an efficiency of greater than 7.2%.” The Examiner respectfully disagrees. Wariishi et al. in view of Osuka teaches all the structural limitations of claims 1-4 as described above, therefore the dye-sensitized solar cell of Wariishi et al. in view of Osuka would obviously achieve an efficiency of at least 7.2%. Furthermore, Wariishi et al. further suggests that a broadening photoelectric conversion wavelength region would increase photoelectric conversion efficiency (See col. 26 lines 56-65, col.54 lines 47-57 of Wariishi et al.). Osuka teaches porphyrin polymers having a broad light absorbance (See Figures 1-2). Therefore it would have been obvious to one skilled in the art that dye-sensitized solar cell of Wariishi et al. in view of Osuka can have a solar radiation conversion efficiency of at least 7.2%.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh-Truc Trinh whose telephone number is 571-272-



6594. The examiner can normally be reached on 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Edna Wong/

Primary Examiner, Art Unit 1795

TT  
08/28/2007